Effect Of Capacitor Bank on Harmonics In Grid Connected PV System

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ABSTRACT

Photovoltaic systems are in high demand now a days due to its property of clean energy and it is pollution less. With increasing demand, grid connected photovoltaic system are also being used. Its impact on power quality of the system is major concern therefore Reducing harmonic content in the grid connected power system is very important. In this paper , effect of adding capacitor bank is analyzed. For simulation study PV connected system of Dr. C.V. Raman university, Kota is considered .For simulation study ETAP software is used. The system parameters are taken from actual site condition.

Keywords- PV Solar, Harmonic, power quality, LV distribution system, capacitor bank.

INTRODUCTION

The power quality of electrical power systems has a severe influence on control and utilization of power. Electrical power systems behave like nonlinear loads, creating a deformed waveform that is made up of voltage and current harmonics. Voltage and current harmonics created by these nonlinear loads cause problems such as increasing power losses, degrading the conductors, and as a result have negative effect on the distribution systems and other electrical segments. It is therefore essential to evaluate the complete effect of these harmonics. The sum total of the various harmonics present in a system is called Total Harmonic Distortion (THD). THD gives the opportunity to evaluate the extent of distortion in a system.

Total Harmonic Distortion (THD) is the common used index to indicate the level harmonic distortion the THD can be calculated using

$$THD = \frac{\sqrt{\sum_{2}^{\infty} F_i^2}}{F_1} \qquad (1)$$

Where F_i is the amplitude of ith harmonic, and F1 is for fundamental component[3].

Individual frequency components are aggregated based on rms calculation as shown in below equation

$$F_{n,vs} = \sqrt[2]{\frac{1}{15}\sum_{i=1}^{15} F_{n,i}^2}$$

Where F represent voltage (V) and current (I) in rms value represent the harmonic order, I is a simple counter [4].

METHODOLOGY

Single line diagram of PV connected distribution system of Dr. C.V.Raman University is shown in figure 1. At present distribution system is supplied from 315kVA, 11000/415V Grid connected Transformer, 10kW solar panel is also grid connected through 415 V system at Bus 5. Simulation is done by using ETAP software.
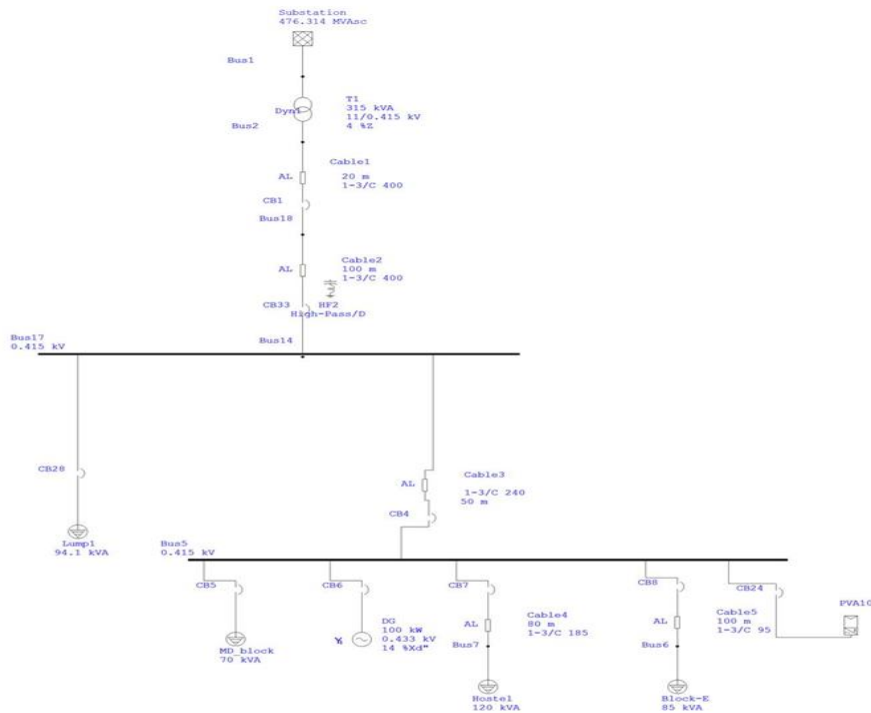

Fig.1 Distribution system single line diagram of Dr.C.V .Raman   University

Total Harmonic Distortion analysis is performed for the single line diagram as shown in figure.1 and it is found that the THD at bus3 and bus5 is 4.02%, and 3.50% respectively. To reduce this harmonic content in the system capacitor bank connection is considered.
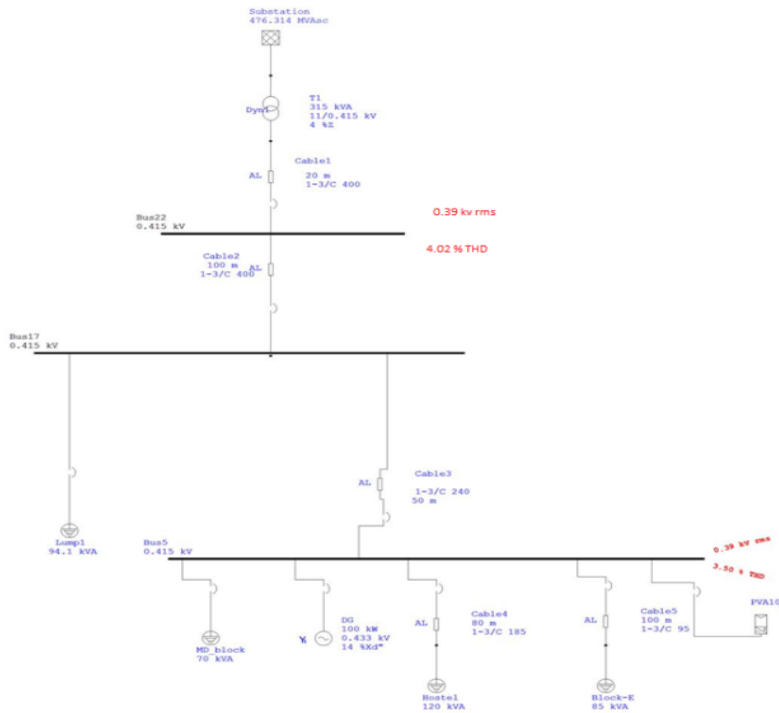
Fig.2 THD analysis of 10kW Grid connected PV solar system

The objective of this research is to analyze the effect of capacitance bank on the harmonics for PV Integrated system in order to avoid exceeding harmonic limits therefore the future problem that will arise due to the large integration of grid connected PV solar system can be avoid during initial planning. [6,9]. In order to reduce the harmonic content , different values of capacitor bank is considered and simulated. capacitor bank is connected at bus 3 via a circuit breaker. Simulation results for different ratings of capacitor bank are mentioned below:
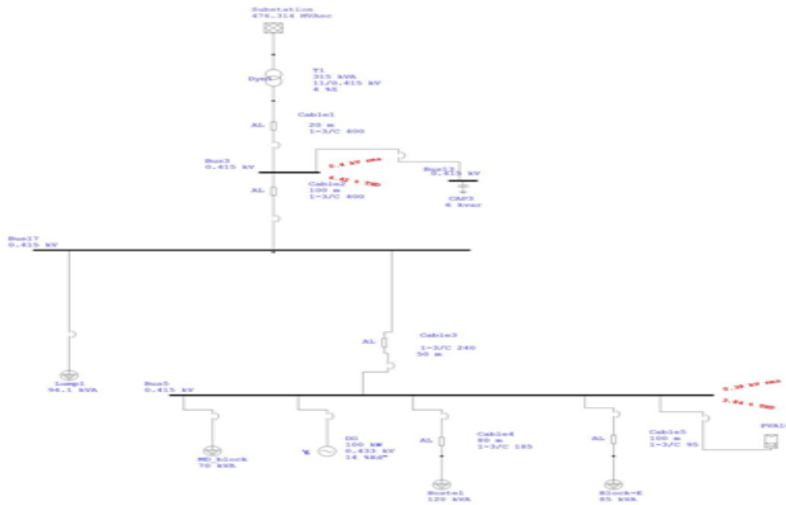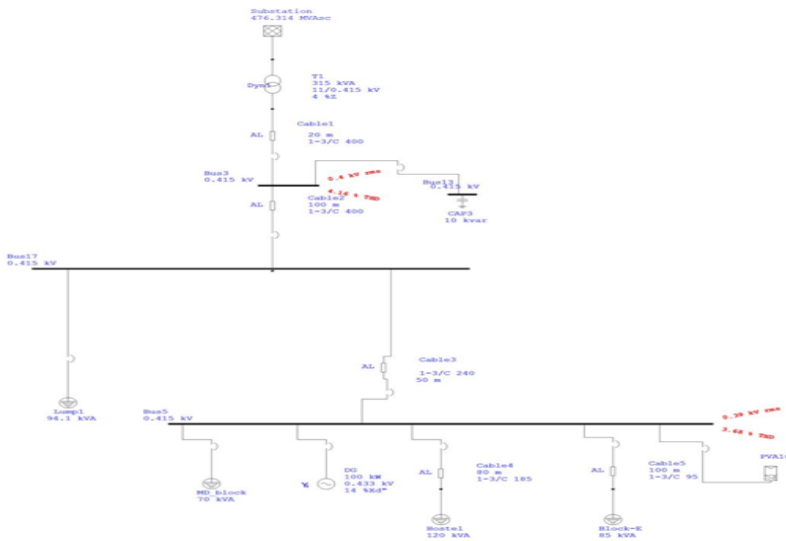
Fig. 4 THD Analysis for 3KVAr capacitor bank

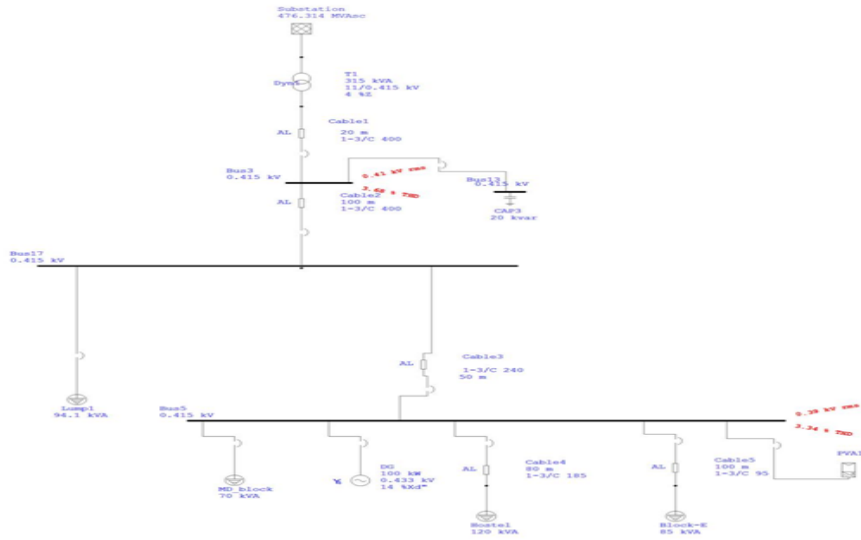Fig. 5 THD Analysis for 5 KVAr capacitor bank

Fig. 6 THD Analysis for 10 KVAr capacitor bank

RESULT

From above analysis ,THD at different capacitor bank rating are considered and values that are obtained are as follows:-

CAPACITOR RATING	THD AT BUS 3	THD AT BUS 5
3KVAr	4.42	3.84
5KVAr	4.16	3.68
10KVAr	3.68	3.34

For small value of KVAr rating of capacitance bank, harmonics gets increased.For higher value of capacitance bank harmonics decreases very sharply.

CONCLUSION

THD analysis of LV grid connected PV System is done for different value of capacitor bank. Harmonics decreases with increasing KVAr rating of capacitor bank. As harmonics decreases, power quality of the system improves. Thus proper utilization of capacitor bank is essential for efficient working of grid connected PV distributed system. Therefore it is required to have a proper study of PV Grid connected power system. The analysis from such studies will help to manage harmonic of the PV connected power system, further we can employ harmonic filters to reduce harmonics.

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